

What is claimed is:

1. A functionalized phosphoinositide polyphosphate comprising a carbon backbone, a phosphatidylethanolamine head group at carbon position 1, and a PtdInsP_n head group at carbon position 4.
2. A functionalized phosphoinositide polyphosphate of claim 1, wherein said carbon backbone is selected from the group consisting of 2,3-diacylthreitol, erythritol and a synthetic module.
3. A functionalized phosphoinositide polyphosphate of claim 2, wherein said synthetic module is prepared and coupled with a PtdInsP_n head group.
4. A functionalized phosphoinositide polyphosphate of claim 3, wherein said PtdInsP_n head group is selected from the group consisting of (PI, PI(3)p, PI(4)P, PI(5)P, PI(4,5)P₂, PI(3,4)P₂, PI(3,5)P₂, PI(3,4,5)P₃).
5. A functionalized phosphoinositide polyphosphate of claim 1, further comprising a reporter group.
6. A functionalized phosphoinositide polyphosphate of claim 5, wherein the reporter is selected from the group consisting of a flourophore, a spin label, biotin, a radio label, a chemiluminescent label, a photophore, a chromophore, a nanogold particle and mixtures thereof.
7. A functionalized phosphoinositide polyphosphate of claim 6, wherein the flourophore is selected from the group consisting of acrylodan, AMCA, BODIPY, Cascade-Blue, CINERF, dansyl, dialkylaminocoumarin, eosin, erythrosine, fluorescein, hydroxycoumarin, NBD, Oregon green, PyMPO, pyrene, rhodamine, Rhodol Green, TMR, Texas Red, and X-Rhodamine.

8. A functionalized phosphoinositide polyphosphate of claim 5, wherein the reporter is covalently attached to a free amino group on the phosphatidylethanolamine head group.
- 5 9. A functionalized phosphoinositide polyphosphate of claim 8, wherein the reporter is attached to a free amino group by a linker.
10. A functionalized phosphoinositide polyphosphate of claim 9, wherein said linker comprises an oligo-polyethylene glycol linker.
- 10 11. A functionalized phosphoinositide polyphosphate of claim 9, wherein said linker may include an additional or alternative linker.
12. A functionalized phosphoinositide polyphosphate of claim 11, wherein
15 said additional or alternative linker is selected from the group consisting of a diamino linker, a linker utilizing both phospho- and non-phospho linked spacers, a phosphatidylserine linker and a carboxylic acid linker.
- 20 13. A functionalized phosphoinositide polyphosphate of claim 11, wherein said linker includes aminoalcohols, heteroatom-containing derivatives or branched aminoalcohols.
- 25 14. A functionalized phosphoinositide polyphosphate of claim 13, further comprising a diamino linker.
15. A functionalized phosphoinositide polyphosphate of claim 1 selected from the group consisting of Pea-PI, Pea-PI(3)P, Pea-PI(4)P, Pea-PI(5)P, Pea-PI(3,4)P₂, Pea-PI(3,5)P₂, Pea-PI(4,5)P₂ and Pea-PI(3, 30 4,5)P₃.

16. A functionalized phosphoinositide polyphosphate of claim 1, wherein the carbon backbone comprises 2 acyl chains having from 2 to 26 carbons.
- 5 17. A functionalized phosphoinositide polyphosphate of claim 1, wherein the carbon backbone comprises an ether chain in the place of one or both acyl chains.
- 10 18. A functionalized phosphoinositide polyphosphate of claim 1, further comprising one or more phosphate groups that have been chemically modified to stabilize the compound against chemical or enzymatic hydrolysis.
- 15 19. A functionalized phosphoinositide polyphosphate of claim 1, further comprising a polymerizable group.
- 20 20. A method of screening for phosphoinositide-specific binding proteins comprising (a) contacting a functionalized phosphoinositide polyphosphate comprising a carbon backbone, a phosphatidylethanolamine head group at carbon position 1, and a PtdInsP_n head group at carbon position 4 with a putative phosphoinositide-specific binding protein-containing composition; and (b) measuring binding
- 25 21. A method of claim 20, wherein said functionalized phosphoinositide polyphosphate is attached to a surface.
22. A method of claim 21, wherein said surface is selected from the group consisting of plates, beads, liposomes, nitrocellulose and metals.
- 30 23. A method of claim 21, wherein said attaching a functionalized phosphoinositide polyphosphate is selected from the group consisting of streptavidin and NHS activation.

24. A method of claim 20, wherein said functionalized phosphoinositide polyphosphate is selected from the group consisting of Pea-PI, Pea-PI(3)P, Pea-PI(4)P, Pea-PI(5)P, Pea-PI(3,4)P₂, Pea-PI(3,5)P₂, Pea-PI(4,5)P₂ and Pea-PI(3, 4,5)P₃.
25. A method of claim 20, wherein said functionalized phosphoinositide polyphosphate further comprises a reporter.
26. A method of claim 25, wherein said reporter is selected from the group consisting of a flourophore, a spin label, biotin, a radio label, a chemiluminescent label, a photophore, a chromophore, a nanogold particle and mixtures thereof.
27. A method of claim 20, wherein said method comprises an assay selected from the group consisting of an *in vitro* enzyme assay, an *in vitro* agonist assay, an *in vitro* antagonist assay, a cell-based assay, a lipid kinase activity assay, a protein kinase activity assay, a lipid phosphatase activity assay, a protein phosphatase activity assay, a phospholipase assay and a phosphatase activity assay.
28. A method of claim 20, wherein said phosphoinositide-specific binding protein is selected from the group consisting of protein kinases, phosphoinositide kinases, phosphoinositide binding proteins, inositol phosphate binding proteins, lipid phosphatases and phospholipases.
29. A method of identifying compositions that affect phosphoinositide recognition or signaling at a cell membrane comprising (a) contacting a functionalized phosphoinositide polyphosphate comprising a carbon backbone, a phosphatidylethanolamine head group at carbon position 1, and a PtdInsP_n head group at carbon position 4 with a composition that putatively affects phosphoinositide recognition or signaling; and (b) measuring recognition and signaling.

30. A method of claim 29, wherein said composition that putatively affects phosphoinositide recognition or signaling comprises a compound selected from the group consisting of a chemical, a natural product,
5 and a synthetic compound.

31. A method of claim 29, wherein said composition that putatively affects phosphoinositide recognition or signaling comprises a compound selected from the group consisting of lipid phosphatases and
10 phospholipases.

32. A method of claim 28, wherein said method comprises a cell-based assay.

15 33. A functionalized phosphoinositide polyphosphate comprising Pea-PI, Pea-PI(3)P, Pea-PI(4)P, Pea-PI(5)P, Pea-PI(3,4)P₂, Pea-PI(3,5)P₂, Pea-PI(4,5)P₂ or Pea-PI(3, 4,5)P₃.

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